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Contrasting magma evolutions at Mt. Erciyes and Mt. Hasan stratovolcanoes, Central Anatolia, Turkey

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Mt. Erciyes (3917 m a.s.l.) and Mt. Hasan (3253 m a.s.l.), the two highest stratovolcanoes of Central Anatolia, Turkey, exhibit magmatic activity since at least 300 ka. Due to their close vicinity of only 120 km, their magmatic evolutions in a post-collisional intraplate setting can be compared and contrasted. Here, we present U-Th disequilibrium and U-Pb (crystallization) and (U-Th)/He (eruption) ages and trace elements of zircon rims and interiors and magnetite-ilmenite thermometry for a comprehensive set of 38 samples from both volcanoes. Samples comprise lava and pyroclastic deposits of intermediate to evolved compositions (63 – 76 wt. % SiO_2).

Zircon rims from both volcanoes show continuous crystallization age spectra. Zircon interior age spectra for Mt. Hasan are also continuous, whereas those for Mt. Erciyes show distinct crystallization peaks at ca. 10, 90 and 280 ka. These pulses coincide with intense eruptive phases separated by quiescent episodes for Mt. Erciyes, whereas eruptive recurrence at Mt. Hasan is at briefer intervals of ca. 5 – 15 ka over the last 60 ka. Eruption temperatures average 810 ˚C for Mt. Erciyes' early Holocene rhyodacitic domes Karagüllü, Dikkartın and Perikartın, their related pyroclastics, and the dacitic Yılanlıdağ dome. For Mt. Hasan, eruption temperatures are around 850 ˚C for most dacitic lavas and block-and-ash-flows, but in some cases up to 1040 ˚C. Thus, eruption temperatures are usually 50 – 120 ˚C hotter than mean Ti-in-zircon crystallization temperatures of 730 and 750 ˚C, respectively, emphasizing the significant reheating of erupted magma batches.

Long-term magma fluxes are estimated at 0.5 – 5 km^3/ka based on zircon crystallization age spectra for both Mt. Erciyes and Mt. Hasan. Episodes of intensified zircon growth and eruptive activity at Mt. Erciyes may be related to transient recharge at higher rates. Protracted zircon rim crystallization indicates continuous presence of small fractions of melt in both systems. This is explained by minor but frequent magma recharge, supported by frequent eruptions in case of Mt. Hasan. The overall longevity of zircon crystallization suggests that magmatic activity persists to the present day at both volcanoes. Melt presence and Holocene eruptive activity (previously unrecognized for Mt. Erciyes) emphasize the hazard potential for the population in the surroundings of Mt. Hasan and Mt. Erciyes including the metropolis of Kayseri with 1.4 million inhabitants in close proximity to Mt. Erciyes, calling for further investigations of both volcanoes.